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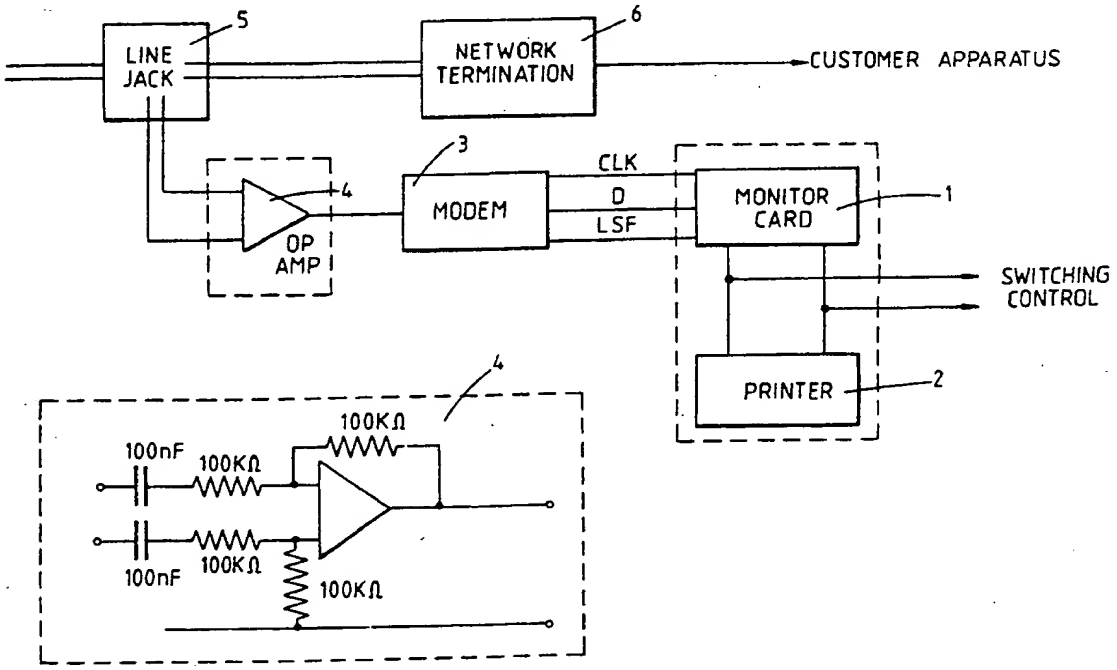
(54) Monitoring apparatus

(57) To permit monitoring of 64 kbs lines a modem 3 with a monitor card 1 is installed in parallel with a customers line termination 5. In the event of a local line fault being identified a printer 2 prints out the time of occurrence and local line fault details. Network faults (identified by a received data fault code) are separately identified by the monitor card and result in a different print identification. Either fault may cause switching to an alternate link responsive to signals from the monitor card 1.

Fig. 1.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

GB 2 222 351 A

Fig. 1.

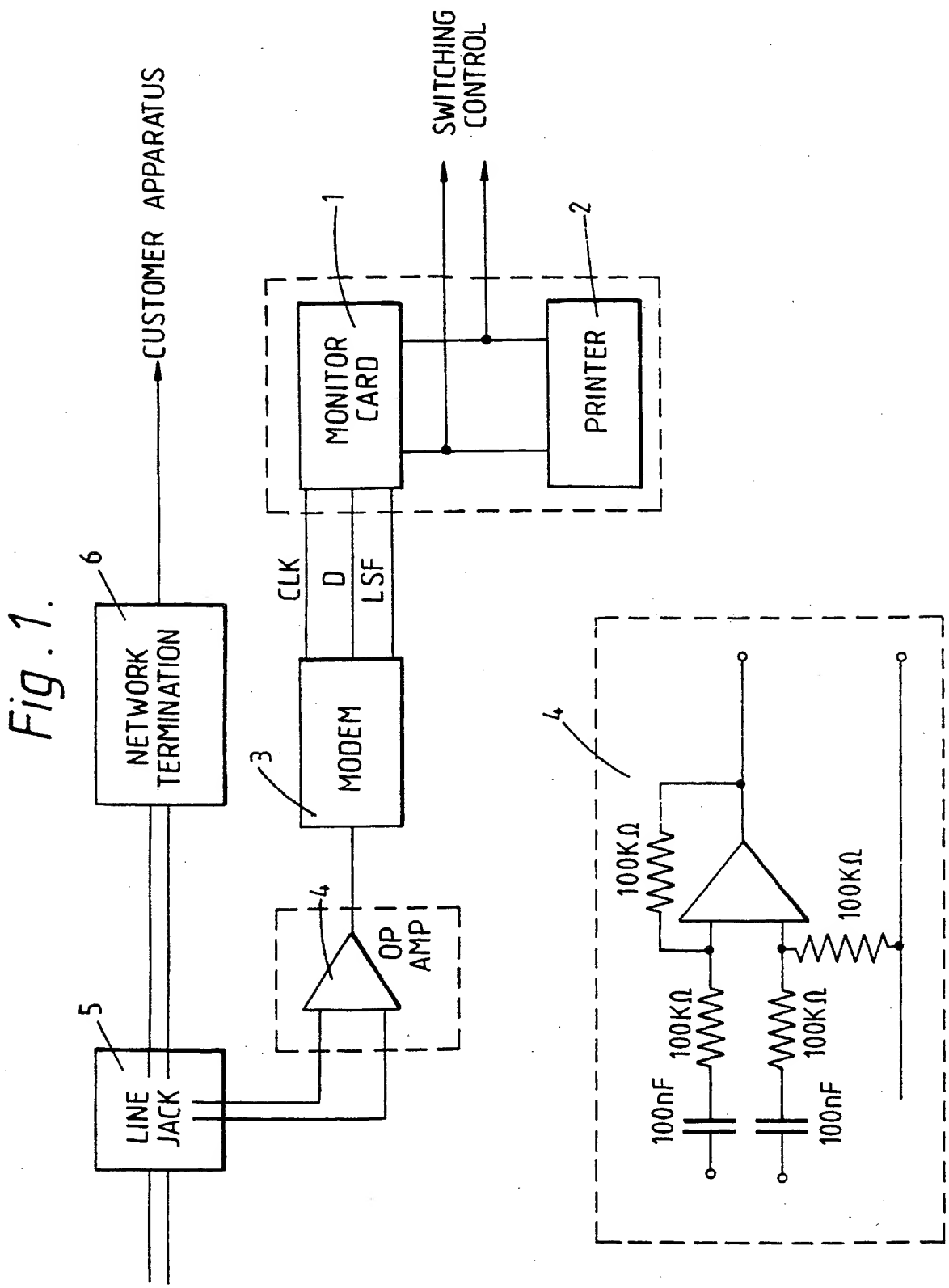


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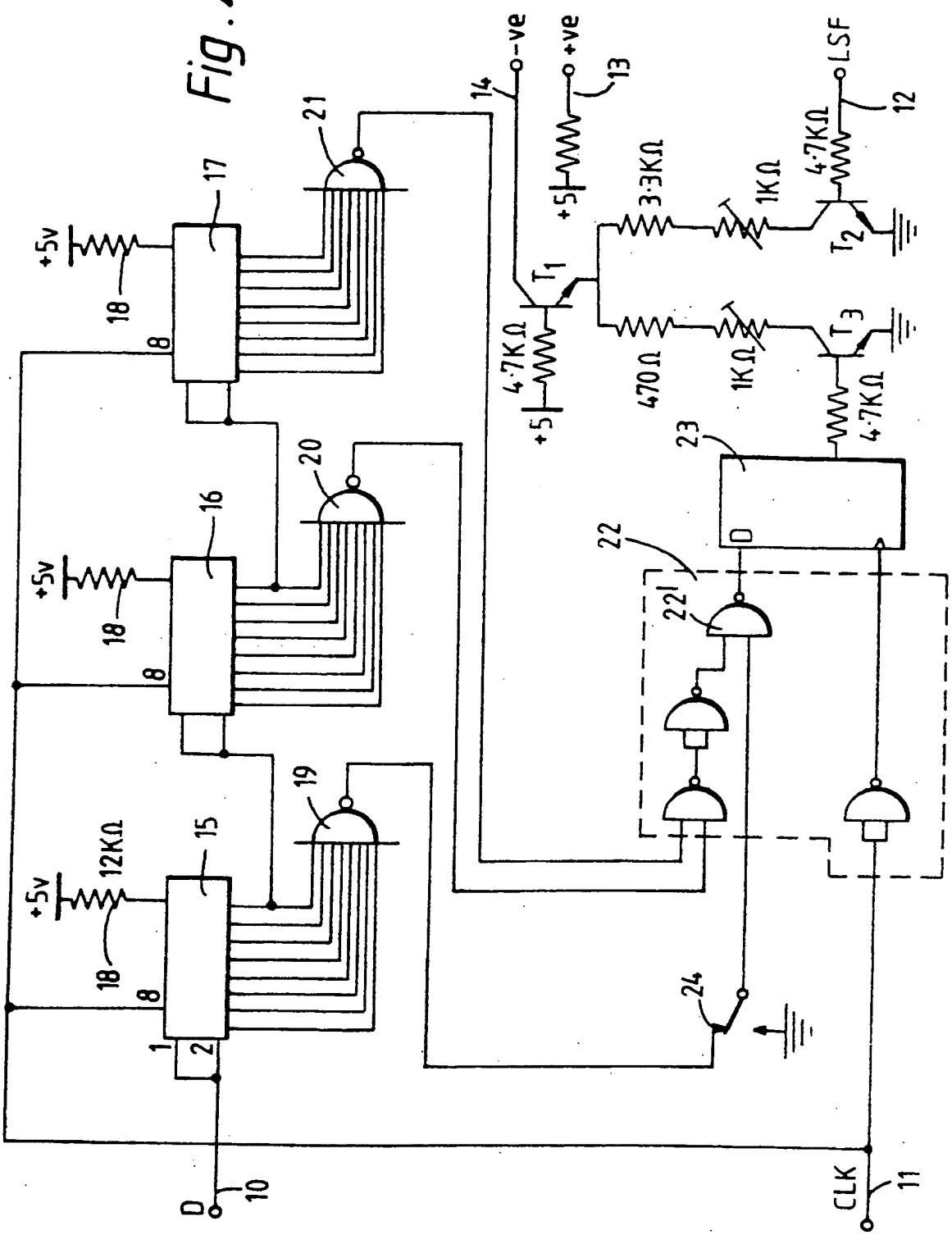
Fig. 2.


PRINTER OUTPUT
-ve
+ve
LSF
14
13
12
+5v
3·3KΩ
1KΩ
4·7KΩ
T1
T2
T3
470Ω
17
16
15
18
8
21
20
19
12KΩ
22
22'
23
24
D
10
CLK
11
1
2

2222351

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WP No 0907K

MONITORING APPARATUS

The present invention relates to monitoring apparatus and in particular to such apparatus for monitoring digital communications links.

Many customers of telecommunications service providers require to transfer data between (eg) computer terminals and computers located at different sites. In order to assist such customers such telecommunications network providers install high capacity data lines from the customers premises to exchanges where the data is multiplexed for onward transmission on high quality digital networks.

One example of such service is that provided by British Telecommunications plc with their "Kilostream" (trademark) lines. Kilostream lines can operate at rates up to 64 kilobits per second in the local network (ie between a local exchange and customers premises). Various customers data channels are time division multiplexed at the local exchange with other 64 kbps channels for national and/or international transmission on a network operating at megabit rates.

One difficulty with systems of this kind is that in the event of a data failure, the customer is unable, easily, to distinguish between terminal faults and network faults. Furthermore, on 64 kbs links the network provider may have no means of in service monitoring capable of rapidly identifying the cause of such failures.

It is therefore an object of the present invention to provide monitoring apparatus capable of identifying and notifying such faults.

According to the present invention there is provided monitoring apparatus for connection to a digital communications circuit, the apparatus comprising register means for sequentially storing n bits representing most recently received data received on the communications circuit, comparison means arranged to compare the n stored bits with a predetermined sequence inserted by network apparatus on identifying a network fault, and alert means responsive to the comparison means to record each occurrence of the predetermined sequence.

Monitoring apparatus in accordance with the invention will now be described by way of example only with reference to the accompanying drawings of which:-

Figure 1 is a block schematic diagram of a system using the apparatus; and

Figure 2 is a circuit diagram of the apparatus.

Referring to Figure 1, the monitoring apparatus comprises a monitor card 1 and a printer 2. The monitor card 1 is linked to the demodulation side of a modem 3 of known kind and is preferably on a secondary circuit board co-located with the modem card.

The modem 3 receives incoming data signals from a parallel connection to a kilostream network line jack 5 by way of an isolation device such as an operational amplifier 4 which increases the signal strength from the line.

Connection from the line jack 5 by way of network termination circuit to the customers apparatus is not affected by the addition of the circuits 1 to 4.

dispositif d'isolation tq un AO

The modem card 3, operating in the known manner to provide conversion between local line signals and base rate data signals provides a clock signal (CLK) demodulated data (D) and line signal failure (LSF) signals to the monitor card 1. On receiving a line signal failure (resulting from a local line fault) the monitor card causes the printer 2 to print out an error message comprising the time of occurrence and the message "Line Alarm".

Once the LSF signal restores the printer then prints the time and the message "error free". Thus if a failure results from a local fault, the time at which this occurs is apparent to the user of the termination.

The more important use of the monitor card 1 is to detect higher order failures in the data link which is carried out by an analysis of the data carried by the "D" wire output from the modem. Once such a failure is detected, the monitor card 1 causes the printer to output a message comprising the time and date and a network alarm message. Again on clearance of the fault, the printer is caused to print the message comprising time, date and "error free".

In the case of both local and network faults the output from the monitor card 1 may be used to cause an alternative link to be tried by forwarding signals to a switching control unit (not shown).

To consider the operation of the monitor card 1, reference is now made to Figure 2 to which the D, CLK and LSF signals are provided on inputs 10, 11 and 12 respectively. The printer, of the kind responsive to current signals, is connected to outputs 13 and 14

respectively providing positive and negative fed current outputs. A suitable printer is an UPLEC printer which includes an internal "real time" clock and which is responsive to current variation to print selectable messages.

In the present case the printer is arranged to respond to a five milliamp current to print an error free message, a one milliamp current to print a network fault message and a current disconnection to print the line alarm message.

The circuit acts on data received on the "D" input 10 using a shift register cascade comprising shift registers 15, 16, 17 which have their respective reset inputs inhibited by 12 kilohm resistors 18 connected to a five volt power supply. The clock signal received on input 11 causes data to clock through the cascade to provide serial to parallel conversion with the latest received twenty-four data bits stored. Any previously received data is discarded. The three shift registers 15, 16, 17 are suitably integrated circuits type 74HCT164.

The outputs from the shift registers 15, 16, 17 are connected to respective eight input NAND gates 19, 20, 21 (suitably integrated circuit type 74HCT30), the outputs of the NAND gates being further combined in an AND selection circuit 22 (integrated circuit type 74HCT02). As thus far described, reception of twenty-four consecutive data bits of value binary 'one' will cause a D type bistable flip-flop 23 (integrated circuit type 74HCT74) to switch between occurrences of the clock signal. For the avoidance of doubt it is here noted that the clock signal is inverted using one of the four available NAND gates in the circuit 22 effectively delaying sampling of the outputs of NAND gates 19, 20, 21 for half a clock period

to remove the possibility of spurious signals in the AND circuit causing an unknown or unstable output condition.

The output from the flip flop bistable 23 is supplied by way of a 4.7 kilohm resistor to a transistor T3 which acts as a current switch which controls the flow of current through a constant current generator comprising transistor T1, and the combination of resistors and transistors connected in the path from T1 to earth.

Thus, in the case of a data failure, transistor T3 in switching off ceases to draw current through transistor T1.

However, current is still drawn through T1 by way of a 3.3 kilohm resistor, a one kilohm variable resistor and transistor T2 to earth resulting in a one milliamp current through output 14 (printer network fault condition)

In normal service, current drawn through transistor T1 by way of the path through transistor T3 amounts to four milliamps which with the one milliamp through the path through transistor T2 results in a five milliamp current to the output 14 (printer error free condition).

In the case of a line signal fault (LSF) signal from the modem being received, transistor T2 is turned off. Since in a line signal fault condition the data line input 10 carries a constant 'zero' condition, the shift register cascade 15, 16, 17 also detects an apparent network fault condition resulting in transistor T3 turning off as hereinbefore described. In consequence no current is drawn through output 14 and transistor T1 which causes the printer to print the line alarm message.

Since some customer multiplexes associated with a kilostream circuit are capable of transmitting strings of binary '1's of sixteen or more bits during idle conditions, for example for synchronisation purposes, a switch 24 is provided in circuit to eliminate such conditions being registered by the monitor card 1. In one position a permanent earth signal is provided to NAND gate 22' thus causing the bistable flip flop 23 to switch when sixteen consecutive binary one signals are received. In the position shown the switch 24 connects the output of NAND gate 19 to one input of the NAND gate 22' thus requiring the shift register 15 to store all 'one's prior to an error signal arising. The circuit thereby only responds to twenty four consecutive signal elements.

It will be appreciated that either the output of the flip flop 23 or an output derived from the current switching circuit may be used to provide signals to a control circuit arranged to set up an alternative data line if required.

CLAIMS

1. Monitoring apparatus for connection to a digital communications circuit, the apparatus comprising register means for sequentially storing n bits representing most recently received data received on the communications circuit, comparison means arranged to compare the n stored bits with a predetermined sequence inserted by network apparatus on identifying a network fault, and alert means responsive to the comparison means to record each occurrence of the predetermined sequence
2. Monitoring apparatus as claimed inb Claim 2 in which the alert means comprises a printer.
3. Monitoring apparatus as claimed in Claim 2 in which the alert means comprises a real time clock, the alert means causing the printer to record the time of occurrence of each network fault.
4. Monitoring apparatus as claimed in Claim 3 in which the alert means is responsive to the comparison means to identify clearance of a network fault and to cause the printer to record the time of occurrence of such clearance.
5. Monitoring apparatus as claimed in any one of Claims 1 to 4, the apparatus further comprising switch means responsive to alert means to cause connection of terminal apparatus on the monitored line to switch to an alternative line.
6. Monitoring apparatus as claimed in any preceding claim in which the alert means is also responsive to a line signal failure indicator to cause recording of such an event.

7. Monitoring apparatus as claimed in any preceding claim in which the comparison means is switchable to monitor for a different predetermined sequence.

8. Monitoring apparatus as claimed in any preceding claim in which the register means comprises at least one serial input shift register.

9. Monitoring apparatus as claimed in Claim 8 in which n outputs of the shift register(s) are passed to a logic AND function whereby the alert means is activated by received data consisting of n consecutive symbols of one polarity.

10. Monitoring apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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